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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : A61F 13/15 — **A1**

(11) International Publication Number: WO 92/02199

(43) International Publication Date: 20 February 1992 (20.02.92)

(21) International Application Number: PCT/GB91/01367

(22) International Filing Date: 9 August 1991 (09.08.91)

(30) Priority data:
9017546.4 10 August 1990 (10.08.90) GB

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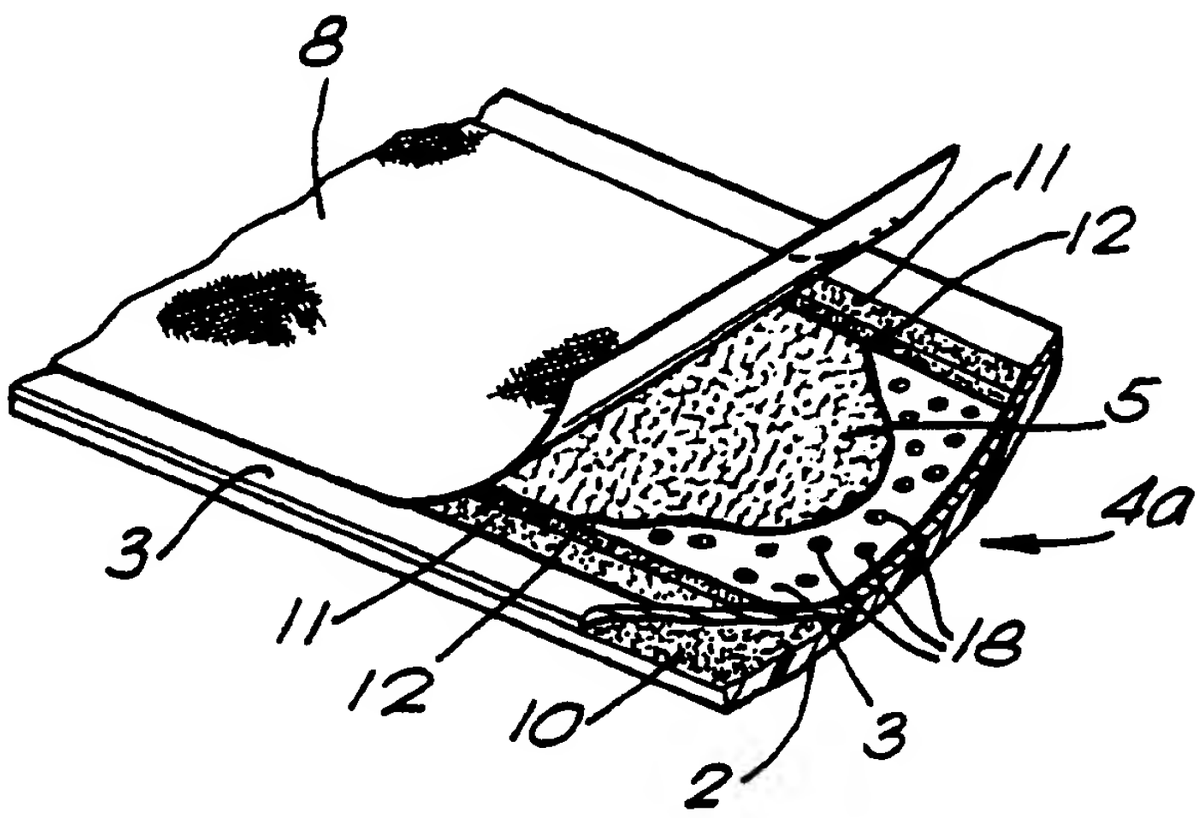
(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: DISPOSABLE COMPOSITE MATERIALS



(57) Abstract

A composite material (4) for use as, or to provide, a disposable product, such as a nappy/diaper, said composite material being flushable and biodegradable and comprising an outer soluble layer (2) supporting a disintegratable and dispersable liquid absorbent layer (5), and a liquid impervious barrier (3) interposed between the soluble layer (2) and the absorbent layer (5), with the soluble layer and liquid impervious barrier being in synergistic relationship, whereby the composite material maintains its integrity during normal use but loses its integrity in response to the action of water when disposed of in a water flushing system. When the composite material is used, for example as a nappy/diaper, a skin-contacting cover which is also biodegradable covers the absorbent layer (5).

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DISPOSABLE COMPOSITE MATERIALS

This invention relates to composite materials and products made therefrom and more particularly to so-called disposable materials and products.

Cultural requirements rise and fall as a function of social change. As part of this process the past two decades have been a period of monumental technical activity resulting in sophisticated, mobile and demanding populations of the so deemed western countries.

The result of these new demands has been an increase in consumer artifacts which obviate activities simply accepted but considered laborious and arduous by previous generations. For example, disposable products have entered into many areas initially as alternatives but now in some areas have become the norm. However, many disposable products can be difficult to dispose of, do not disperse or degrade easily, or not at all, and are not environmentally friendly. Nowadays, it is generally accepted that environmentally damaging products are unwelcome in a world composed of thinking, dynamic, sophisticated societies. And, fortunately a main feature of rec nt cultural change of many such societies has been towards environmental care, protection and preservation. One of the main obstacles to this preservation is the dramatic increase in non-degradable waste of which not an insignificant amount is caused by so-called disposable products.

To take one example, in 1983, 820 million nappies (diapers) which could be described as disposable were used in the United Kingdom alone. This figure rose to 2,500 million in 1988 and the suggestion is that an increase in use will continue, ending only with the final demise of the once traditional terry nappy (diaper).

Although helpful to parents and beneficial to the child the harm to the environment has been considerable. In parallel with other problems of waste disposal, the throw away nappy (diaper) has become a cause of great concern. In America the crisis is of such dimensions that imaginative methods of disposal have resulted in the manufacture of flower pots from used diapers (nappies). It must be said, however, that such schemes will never cope with an increasing number of nappies now waiting for time consuming natural degradation. Incineration is not an answer as it contributes to the greenhouse effect. Attempts to flush disposable nappies down the lavatory leads to blockage of drains and consequential health hazard. And the same applies to sanitary towels and incontinence pads.

Another disadvantage of known disposable absorbent nappies is that their ability to absorb liquid is restricted by the phenomenon known as "gel block". This occurs because the super absorbent granules which are used currently in such nappies and which rely on their molecular structure to absorb and hold the liquid, swell in size to such as extent that they touch each other and prevent further absorption. Thus, such nappies have to be changed relatively frequently, which is not always possible or desirable, if the child is to be kept free from wet clothing and the risk of nappy rash.

Moreover, the absorbency of currently available sanitary towels and incontinence pads or knickers is not sufficient always to avoid the embarrassment of leakage.

But even if there were available, which has not hitherto been so to the best of Applicant's knowledge, an absorbent material of such a construction and nature and of sufficient absorbency as to avoid the aforementioned gel block and absorbency problems, the material would still need to be at least disintegratable and disposable in flushing systems without blocking the drains and also, preferably, biodegradable. The

biodegradable nature of the absorbent material would then more readily enable the disintegrated and dispersed biodegradable material to be ingested by the bacteria in a sewage system without the possible risk of any harm to the environment. But, hitherto, Applicant has not been aware of any biodegradable materials which are suitable for disposable products such as nappies, sanitary towels and incontinence pads or knickers, for example.

However, absorbent materials must have some support or containing envelope of requisite strength and handling capability if they are to retain their integrity, eg in a nappy, sanitary towel or incontinence pad. But such supports or containing envelopes in order to function are made of a non-water soluble material e.g. P.V.C. or polypropylene, sheets and or cotton or synthetic threads or meshes, which do not disintegrate or disperse when flushed down the lavatory, for example. Water soluble plastics materials having the desired strength and handling capabilities are, of course, well known. A particular and established water soluble plastics material is polyvinylalcohol (PVA or PVOH) which has been used in film form to form sachets to contain such substances as bath salts so that the sachet dissolves when placed in contact with water. However, as will be appreciated, soluble films cannot be used as a support for liquid absorbent materials. Traditionally, therefore, water insoluble plastics carriers have used to contain or support, and provide the necessary strength and handling capabilities for, the absorbent material, which would otherwise disintegrate or fall apart rendering the product unfit for its continued intended use.

Thus, there has long been a need for products which are truly disposable, ie can disintegrate and disperse under the natural action of environmental forces or in water flushing systems without causing any harm to the environment or any health hazard.

Accordingly,the main object of the present invention is to provide composite materials for use in disposable products such as nappies, sanitary towels, incontinence pads or knickers, in which the aforesaid disadvantages are reduced or overcome.

Applicant has discovered a principle which is that, surprisingly, a combination of soluble and liquid impervious materials can be used in disposable products such as nappies, sanitary towels and incontinence pads, for example, and yet permit disintegration and dispersal of the product when it is, say, flushed down a lavatory.

It should be appreciated that, in this specification, the term "soluble" is used in its broadest sense or meaning to cover the response of a material to the action of a liquid such as, and usually, water, which is found in say a flushing system or sewage system, which results in that material losing its integrity, eg by dissolving, dispersing, degrading, biodegrading and/or disintegrating in the liquid.

In order to carry this principle into effect and in accordance with one aspect of the invention, a composite material comprises a layer of soluble material and a liquid impervious barrier, each of which layer and barrier, during normal use, is capable of maintaining the integrity of the other.

Accordingly there is formed a composite material of which one surface, the outer in use, can be attacked by a liquid such as water to cause it to lose its integrity, whilst still providing sufficient support to the liquid impervious barrier to enable it to fulfil its function and of which the other surface, the inner surface in use, prevents a liquid such as water from attacking the outer layer. It can be said that the soluble outer layer provides sufficient mechanical strength and handling capability for an ultimate product whilst the

liquid impervious barrier has insufficient strength and handling capability in its own right.

Therefore the outer soluble layer and inner liquid impervious barrier interact, are synergistic, depend upon or rely on each other to maintain each other's integrity and therefore the integrity of the composite material.

Thus, the present invention may be expressed in terms of a composite material comprising a layer of soluble material and a liquid impervious barrier, with said layer and said barrier being in synergistic relationship.

By means of the invention, the soluble material will loose its integrity when flushed away, leaving the liquid impervious barrier without any support and free to disperse in the flushing water. If say a disposable product such as a nappy is then made from such a composite material by attaching a disintegratable and dispersable layer of absorbent material to the liquid impervious barrier then a truly disposable product can be made.

Accordingly, from another aspect the present invention consists in a composite material which is capable of absorbing and holding a quantity of liquid until disposal is required and which disintegrates and disperses when disposed of in the natural environment or in an available water flushing system.

The layer of soluble material may be of any suitable material, provided that it loses its integrity when disposed of in, say, a water flushing system. For example, a layer of paper could be used like as in paper bags or tissue used for disposable handkerchiefs, table napkins and toilet tissue, as such paper will disintegrate and disperse when disposed of, e.g. by flushing. But other suitable soluble materials such as polyvinyl alcohol (PVA) and more recently available additions to this domain such as carboxymethyl cellulose (CMC), which

may be derived from cotton and alginate derived materials,eg in the form of films, are preferred to paper since they dissolve, i.e. form a solution with the water e.g. in a flushing system. Moreover, PVA, CMC and alginate have better strength and handling characteristics than say paper tissue, are non toxic and biodegradable, and when dissolved in the water present in a sewage system, the bacteria present will ingest and digest the PVA, CMC and alginate in solution thereby destroying them and avoiding the risk of harm to the environment.

Thus, it is preferred that the soluble outer layer of the composite material be biodegradable. The strength and handling capability of the outer layer is such that it does not tear easily and remains undamaged in normal use, as can be readily appreciated.

For ease of manufacture, the soluble outer layer is preferably made of any suitable material, such as a plastics film which may be formed in any appropriate way, for example by blowing, extrusion or casting, as is known.

The material of the liquid impervious barrier may be of any appropriate kind consistent with protecting the soluble layer from dissolution yet permit dispersion when the soluble layer dissolves and is preferably biodegradable like the material for the soluble layer. For example, Applicant has found after considerable research and experimentation that polyvinylidenechloride (PVDC), polycaprolactone, sugar based thermoplastics such as those sold by ICI under the Trade Mark BIOPOL, and other non-petrochemical based thermoplastics not only make suitable liquid impervious barriers in combination with the soluble layer but are also biodegradable. Whilst certain rubber based substances can also be used for the liquid impervious barrier, the other previously mentioned substances are preferred since they are biodegradable. Moreover, Applicant's research has lead to the formulation of

specially contrived homogenous amalgams containing thermoplastic biodegradable materials which are particularly suitable for liquid impervious barrier materials as they provide a tie layer to the soluble outer layer.

The liquid impervious barrier may be bonded to the soluble layer, eg by heat bonding, ultrasonic bonding, by lamination or by means of a suitable adhesive. Preferably, the adhesive is a water soluble adhesive such as a PVA or CMC adhesive, so that the non-water soluble content of the composite material is kept to the minimum consistent with adequate function of the liquid impervious barrier. The adhesive may be applied in a matrix pattern of threads or in strips or dots.

Alternatively, the liquid impervious barrier may be formed at the same time as the soluble outer layer is made so that the soluble layer and liquid impervious barrier constitute an integral (one-piece construction), synergistic, whole. As yet another alternative, the liquid impervious barrier may be formed as a coating on one surface of the soluble layer, and this liquid impervious barrier coating could, in itself, be a non-soluble adhesive, eg a pressure sensitive adhesive, to enable the attachment of an absorbent layer thereto.

The thickness of the soluble layer will depend upon the particular ultimate disposable product concerned and the desirable degree of support for the liquid impervious barrier, adequate strength and handling characteristics and speed of dissolution. Applicant has found in tests that a range of thickness for the soluble layer of from about 20 microns to about 35 microns works. On the other hand, Applicant's tests have confirmed that a liquid impervious barrier having a thickness range in the order of about 1 micron to 10 microns, with about 2 to 5 microns being preferred, works with the preferred soluble layer to enable the liquid impervious barrier to disperse when the soluble layer has lost its integrity.

Having obtained a suitable composite material for supporting or carrying an absorbent material in say a nappy, sanitary towel, incontinence pad or the like, Applicant was still faced with the problems of finding an absorbent material which overcame the aforementioned disadvantages of the known, currently available absorbent materials. Applicant has spent considerable time in research and experimentation in finding and making an absorbent material which not only combats gel block but also disintegrates and disperses when disposed of by natural environmental action or in an available water flushing system.

As a result of such research and experimentation, Applicant has found that non-woven substances which absorb by capillarity and/or by wicking and/or by molecular containment do not exhibit gel block and that non-woven fibrous or fibre-based materials, such as flocks, are particularly useful examples. Flocks are characterised by having a central core which is not fibrous but carrying a multiplicity of short-length fibres. Thus, in this specification the terms fibrous and fibre-based also includes materials containing more than just fibres. But the normal way in which to bond such non-woven fibrous materials together to maintain the integrity of the absorbent material is to include heat bonded fibres within the non-woven fibrous matrix and use heat bonding to form a fibrous web. Unfortunately, such heat bonded fibres and heat bonding prevents adequate disintegration of the web and therefore dispersal. With further research and experimentation Applicant found that a web of non-woven fibrous absorbent materials could be formed without heat bonding fibres being included by forming the web in the presence of water vapour, eg in a humid atmosphere, which causes the constituents of the web including the absorbent fibres to be lightly adhered together to maintain sufficient integrity of the web during normal use yet not prevent ultimate disintegration and dispersion when flushed down the lavatory for example. The use of water to bind the constituents of the web together is

referred to herein as hydro-entanglement.

Accordingly from another aspect, the present invention consists in a method of producing an absorbent material, wherein a web of non-woven absorbent substances is formed and wherein the individual constituents of the web are held together by the action of water.

Ideally, as will be appreciated from the foregoing, the non-woven absorbent substances are fibrous or fibre-based.

Conveniently, the web is formed in a humid atmosphere so that the water vapour present therein effects the holding of the web constituents together and, of course, with an absence of any heat bonding fibre, disintegration and dispersal are enhanced.

The unwoven fibrous material may be formed into a web or soft flock which is non-woven,by carding, air laying in which the constituents of the fibrous material is blown up in a volume of air and random forming by a combination of air laying and carding.

As has been previously mentioned the use of humidity to bond the constituents of the fibrous material is a simple and easy method of bonding the non-woven constituents of the fibrous to produce the web, instead of ultrasonic bonding using needle bosses and latex heat bonding, both of which require heat bonding fibres and militate against disintegration and dispersion of the web.

The invention also consists in a composite absorbent material comprising any of the absorbent fibrous or fibre-based substances referred to herein above, said absorbent material being in the form of a non-woven web of which the individual constituents are preferably bonded together in the absence of any heat bondable fibres.

Absorbent materials made in accordance with the invention are capable of absorbing large quantities of liquid such as water or aqueous solution whilst still combatting gel block. This is because the absorption is by capillarity and/or by wicking and/or by molecular containment or any combination thereof and although the fibrous material swells, fresh liquid continues to be drawn into the web by capillary and/or wicking and/or molecular containment action until maximum absorption has been achieved.

It should be appreciated that whilst the absence of heat bonding fibres within the non-woven web or flock is preferred, the invention does not exclude the possibility of using such fibres if desired or necessary.

Applicant has also carried out numerous tests and experiments on a wide variety of fibrous or fibre-based materials and has found that one super-absorbent material which comprises monomers of isobutylene and maleic anhydride brought together in a cross-linking process which allows them to be spun into a super-absorbent fibrous material and which was at one time supplied by Arco chemicals under the Trade Mark FIBRESORB has a high degree of absorbency. But this FIBERSORB material alone does not meet Applicant's stringent requirements for disintegration and dispersal in combination with absorbency and absence of gel block. Accordingly, Applicant conducted further trials which led to the production of an absorbent material comprising FIBERSORB material and other constituents, which are preferably of the fibrous or fibre-based kind, which gave the requisite web strength, absorption, disintegration and dispersal characteristics.

The results of Applicant's experiments and trials with many combinations of absorbent substances with FIBERSORB material have revealed that the following fibres fulfil the purposes of Applicant's invention, namely polypropylene which is not biodegradable, rayon viscose, a biodegradable thermoplastic

material, a cross-linked acrylic polymer and fluff pulp (a generic term for wood based fibres, in this case unbleached wood pulp). The following examples have been found to be particularly effective, namely composites of about 54% by weight FIBERSORB material with about 46% by weight polypropylene fibrous material; about 35% FIBERSORB material with about 65% by weight viscose rayon fibrous material; about 35% by weight FIBERSORB material with about 20% viscose rayon fibrous material and about 45% by weight fluff pulp; about 35% by weight FIBERSORB material with about 20% by weight biodegradable thermoplastic material and about 45% by weight fluff pulp; and about 50% by weight FIBERSORB material with about 50% by weight CMC's or other biodegradable aborbents.

Now, it is disputed in some circles that absorbent materials comprising substances derived from petrochemical sources, which include the isobutylene and maleic anhydride constituents of FIBERSORB material, are not biodegradable within the strictest meaning of the term "biodegradable". Whilst it would appear that this is because there is reputed to be some evidence to support this view, Applicant has not found any corroborating written research, and, in any event, does not agree. However, since the environmental acceptability of disposable products with which Applicant's invention is concerned is of paramount importance, it is essential that the invention can provide, if required or necessary, preferred absorbent materials which can have no slur, however small, cast upon their ability to biodegrade.

Accordingly, Applicant carried out still further research in relation to, and experiments and trials on, absorbent materials with the aim of finding a biodegradable absorbent material which could fulfil this requirement.

Applicant then researched into materials that were derived from natural sources of the plant and vegetable kingdom with the idea in mind that materials from such sources could not

be other than biodegradable. Applicant has found, as a result of this further work on such plant/vegetable derived materials, that suitable biodegradable absorbent materials can be made from cellulose, eg. CMC's and cellulose rayon fibre, seaweed eg. alginate derived materials, polysaccharides and starch and modified starches, eg. potato derived absorbents of the kind sold under the Trade Mark FOXSORB, as well as fluff pulp which is a plant derived natural source biodegradable material and which has already been referred to herein.

In one particularly advantageous embodiment, the absorbent material comprises a central layer or core member including three constituents, namely fibrous CMC, fluff pulp and rayon fibres which are conveniently non-woven and bonded together either by carding or by hydro-entanglement, as previously mentioned, to form a fibrous web, and two outer members each of which includes three layers of fibrous material of which a middle layer of CMC is sandwiched between two layers of cellulose rayon fibre.

Furthermore, Applicant has made the following combinations of absorbent materials which have been found to be particularly effective in use as well as being biodegradable and which comprise about 35% to 60% by weight CMC's and/or potato derived adsorbents, about 35% to 50% by weight fluff pulp and about 5% to 15% by weight cellulose rayon fibre. A preferred absorbent material comprises about 50% by weight CMC's, about 35% by weight fluff pulp and about 15% by weight cellulose rayon fibre or indeed 50% by weight viscose rayon in an upper and lower web formed with about 50% by weight CMC's or other biodegradable absorbents sandwiched between them.

It should be appreciated that the search for that combination of absorbent substances having the requirements sought by the Applicant involved a considerable number of man hours and has resulted in the production of some unique absorbent materials.

Depending upon the use of the absorbent material, Applicant has found that a suitable range of weights in grammes per square centimetre is about 70 gsm to 400 gsm with a range of about 70 to 250 gsm being preferred. About 70 gsm has been found appropriate for sanitary towels and 250 gsm for nappies but whatever, the use, the thickness of the absorbent layer is significantly reduced as compared to those incontinence pads and knickers for greater absorbency so that wearing comfort and confidence is considerably enhanced.

The absorbent layer is conveniently attached to the liquid impervious barrier, as by a suitable adhesive which can be water soluble such as CMC's or PVA, or if the liquid impervious barrier itself is made of a liquid impervious adhesive by the adhesive of the barrier. However, a matrix or strip or dot formation of water soluble adhesive is generally preferred.

In order to provide what has been referred to herein as a truly disposable absorbent product, such as a nappy, a bag, a sanitary towel, an incontinence pad or knickers, from a further aspect, the present invention consists in a composite material comprising a layer of soluble materia, a layer of absorbent material which is capable of absorbing and holding a liquid and which is supported by the soluble layer and a liquid impervious barrier which is interposed between the absorbent layer and the soluble layer, each of said soluble layer and liquid impervious barrier being capable, during normal use, of maintaining the integrity of the other and thus of the composite material including the absorbent layer, so that the absorbent layer can absorb and hold liquid without disintegration of the composite material.

Thus, by means of the invention, the outer soluble layer provides sufficient strength in itself and to the intermediate liquid impervious barrier in the composite material, thereby enabling the composite material and disposable products such

as nappies made therefrom to remain in their manufactured state during use, when the absorbent layer is absorbing during use and holding the absorbed liquid. But when the composite material or disposable product such as a nappy is subjected to say immersion in water, eg. in a flushing system, or the action of the natural environment, the soluble outer layer loses its integrity by breaking up or disintegrating and disperses, degrades or dissolves away, the liquid impervious barrier remains without cohesive strength or quality and breaks up or disintegrates and disperses according to the forces acting upon it, and the absorbent material, left without the support of the soluble layer, also loses its integrity by breaking up or disintegrating and then disperses, degrades, biodegrades or dissolves away and any waste matter borne by the absorbent material is also dispersed.

In simulated flushing tests carried out on disposable products made from the composite materials of the invention, it has taken around 10 seconds for the soluble layer and any soluble attaching adhesive for the absorbent layer to dissolve and 15 seconds for the entire product to disintegrate and disperse whereafter they degrade or biodegrade. Accordingly, the invention can provide a composite material and disposable products made therefrom which after use can be flushed away in available flushing systems, without ultimately harming the environment or creating a health hazard.

Naturally, the various components and their constituents which have been previously described can be incorporated into the composite material of this aspect of this invention.

Whilst the three component composite material can be used satisfactorily to manufacture such disposable products as nappies, sanitary towels, incontinence pads or knickers and is suitable for absorbent bags, Applicant has found that it is desirable to keep the absorbent material away from the skin of the person and to minimise the risk of any absorbed liquid

reemerging and causing discomfort.

To this end, this aspect of the invention also includes a composite material in which the absorbent layer is covered by a relatively non-absorbent cover layer which provides ease of passage of the liquid to be absorbed therethrough and into the absorbent material and which preferably has resistance to leakage of liquid from the absorbent layer out through the cover layer.

Such a cover layer is preferably of a biodegradable material but should at least be degradable, and in one preferred embodiment is a non-woven fibrous material. In one prototype embodiment, made by the Applicant, the cover layer is in the form of a scrim and can act as an inner cover. By this means there is minimal risk of leakage of absorbed liquid back to the skin which could cause discomfort to the user of the disposable product. The cover layer is conveniently attached at it's edges or edge regions to the absorbent layer by a water soluble adhesive, such as a CMC or PVA adhesive, or alternatively to the soluble layer by folding over the cover layer to provide narrow peripheral strips which are adhesively attached to the outer surface of the soluble layer along the edge of the composite material. The latter arrangement provides the product with smooth and comfortable edges which is important when it is used for nappies, sanitary towels and incontinence pads, for example. Moreover, such an attachment of the inner skin contacting cover layer has the tendency to act to contain any absorbed liquid within the confines of the composite material. The choice of material from which the skin contacting cover layer is made must be consistent with providing the ease of passage and containing characteristics as well as disintegration or degradability, preferably biodegradability, and dispersion once the soluble layer has lost its integrity, eg, been dissolved.

Applicant has found cellulose acetate fibres and fibres made

of a biodegradable thermoplastic material to be suitable non-woven fibrous materials for the cover layer. However, the preferred material for the cover layer comprises a web of biodegradable fibrous material that is preferably cellulose rayon which is advantageously hydro-entangled and that carries a biodegradable thermoplastics material such as BIOPOL material which has been applied in the form of an emulsion to the web. Other suitable biodegradable materials for the cover layer are polycaprolactone which is absorbent resistant and cotton.

As the thickness of the cover layer must, of course, be compatible with ease of liquid passage therethrough and into the absorbent layer and leakage resistance, as well as with loss of integrity by degrading, disintegration and/or dissolution, and dispersion, a preferred thickness range is from about 5 to about 10 microns.

In one embodiment of the invention, the soluble layer is a cast and embossed PVA or CMC film of 20 micron thickness. In the same or another embodiment the liquid impervious barrier is a very thin film which may be co-extruded and be as little as 1 or 2 microns in thickness.

Naturally, it is within the ambit of this invention for the absorbent material to be of a form other than fibrous or to contain non-fibrous materials in addition to fibres, provided that the requisite degree of absorbency, liquid retention, and capability of loss of integrity, eg. by disintegration, and dispersion and preferably biodegradation is obtained.

In a further embodiment the absorbent layer has an annular gap therein, with the liquid impervious barrier being exposed in the gap. Thus, a natural barrier or dry moat is formed to the migration of absorbed liquid to the edges of the composite material with any liquid bridging the gap being mopped up as it were by the surrounding strip of absorbent material.

As will be appreciated from the foregoing, the invention in one of its embodiments provides a flushable, degradable, disposable nappy which enters the domain of environmental concern at an apposite moment, offering an end to the increase in nappy waste.

Moreover, the invention also consists in a composite material, for use as, or to provide, a disposable product such as a nappy, sanitary towel, incontinence pad or knickers, the composite material being constituted by substances that are flushable, biodegradable and capable of losing their integrity by the natural action of the environment or in a flushing system, whereby the dissolution or disintegration and ultimate dispersion can take place without any harm being done to the environment.

The invention is also concerned with methods of manufacturing any of the composite materials, absorbent materials and disposable products referred to hereinabove.

In order that the invention may be more readily understood, some embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic exploded perspective view of one embodiment of composite material, comprising two layers of which one is soluble and the other liquid impervious, made in accordance with the invention,

Fig. 2 is alternative embodiment of two layer composite material to that of Fig. 1,

Figs.3 and 4 are diagrammatic exploded perspective views of further embodiments of composite materials utilizing the basic two layer constructions of Figs 1 and 2 respectively and including a third layer of absorbent material,

Fig. 5 is a perspective view of a composite material utilising the three layer construction of Fig 3 or 4,

Fig. 6 is a perspective view of an alternative embodiment of composite material utilizing the three layer construction of Fig. 3 or 4,

Fig. 7 is a perspective view, with parts broken away, of a four layer embodiment in which the fourth layer is leakage - resistant yet permits ease of liquid passage therethrough into the absorbent layer,

Fig. 8 is a diagrammatic perspective view with parts lifted up and broken away of another embodiment of composite material for use in making a disposable nappy,

Fig. 9 is a perspective view of a disposable nappy incorporating the composite material of Fig.8,

Fig. 10 is a plan view, with a leakage resistant layer lifted up, of a disposable sanitary towel incorporating the composite material of Fig. 7,

Fig. 11 is an underneath plan view of the sanitary towel of Fig. 10,

Fig. 12 is a diagrammatic perspective view of a pair of incontinence knickers incorporating the disposable composite material of Fig. 7,

Fig. 13 is a diagrammatic partially exploded view of yet another embodiment of composite material,

Fig. 14 is a perspective view of a disposable bag made from the composite material of Fig. 13,

Fig. 15 is a plan view of another embodiment of composite

material, and

Fig. 16 is a diagrammatic detail perspective view, to an enlarged scale, of an alternative embodiment of absorbent layer.

In the drawings, the same reference characters are used to designate the same or similar parts.

Referring to Fig 1 of the drawings, there is shown a composite material which is generally indicated at 1, comprising an outer layer 2 of a water soluble and biodegradable material eg a plastics material such as polyvinylalcohol (PVA) or carboxymethyl cellulose (CMC), in the form of a film of say 20 to 35 micron in thickness. Also shown is a separate inner barrier layer 3 of a liquid impervious degradable material such as polyvinylidenechloride, polycaprolactone, BIOPOL material or certain thermoplastic materials, all of which are also biodegradable. The layer 3 thus constitutes a liquid impervious barrier and is in the form of a film of say 1 to 5 micron thick bonded as by a suitable water soluble adhesive such as a PVA or CMC adhesive, by lamination or by ultra sonic or heat bonding to one side only of the soluble outer layer, as will be apparent from Fig. 5. Alternatively, the liquid impervious barrier 3 could be formed as a coating on one surface of the soluble layer 2

The embodiment of Fig. 2 differs from that of Fig.1 in that the composite material comprising the soluble layer 2 and the liquid impervious barrier 3 is of one-piece construction and formed as by extrusion of soluble and liquid impervious materials.

The choice and thickness of the material of the liquid impervious barrier 3 will vary according to the ultimate product and thus according to the particular composite material most suited for that product. In normal use of the

composite material 1, the soluble outer layer 2 and the liquid impervious barrier 3 which is really a very thin liquid proof, eg. water proof, layer, are each capable of maintaining the integrity of the other.

This will become more readily apparent by reference to Figures 3 and 5, which show a composite material, generally indicated at 4 which is a flushable, degradable liquid retaining means comprising a biodegradable layer 5 which absorbs and holds a liquid such as water and waste liquid and which is attached if required to the liquid impervious barrier 3 (Fig 5), eg. by a suitable water soluble adhesive such as a PVA or CMC adhesive. The liquid absorbent layer 5 is in the form of a web of superabsorbent non-woven material containing a high proportion of super absorbent compound in fibrous form, non-limiting examples of which are FIBERSORB (Trade Mark) material, alone or in combination with other specified fibrous substances, and alone or in combination, a cross-linked acrylic polymer, viscose (cellulose) rayon, fluff pulp, biodegradable thermoplastic materials, polypropylene, CMC's, alginate derived materials, substances derived from polysacharides or starches and potato derived adsorbents such as FOXSORB (Trade Mark) substances. For environmental reasons, absorbent layers whose constituent substances or materials are biodegradable are preferred.

Thus, the absorbent material 5 can absorb and hold liquid such as a child's urine, with the intermediate liquid impervious barrier 3 preventing dissolution of the soluble outer layer 2. This latter gives sufficient support to the liquid impervious barrier 3 to enable it to fulfil its function and to the absorbent layer 5 so that, during normal use, the integrity of the absorbent layer is maintained as well as the integrity of the composite material itself and the disposable product made therefrom. Therefore, it can be said that whilst the outer layer 2 has sufficient strength and handling capability, the liquid impervious barrier 3 has insufficient

strength and handling capability in its own right.

However, when the composite material or disposable product such as a nappy made therefrom in which the absorbent material holds liquid waste is disposed of, eg by flushing, the outer soluble layer 2 readily loses its integrity by dissolving, leaving the barrier 3 and absorbent layer 5 without support and strength whereupon they lose their integrity by breaking up or disintegrating and disperse in the water of the flushing and sewage systems where the dispersed or dissolved constituents of the composite material can degrade or biodegrade as the case may be.

The absorbent layer 5 in Fig 5, does not extend to the edges of the composite material, which it does in the diagrammatic embodiments of Figs 3 and 4, but occupies a central area leaving an annular peripherally extending zone 6 of exposed liquid impervious barrier 3 which guards against leakage from the composite material 4.

Referring now to Fig 6, this embodiment differs from that of Figure 5 in that the absorbent layer 5 has a main central absorbent area 5a which is separated by an annular gap or moat 7 where the impervious barrier 3 is exposed, from a peripheral or edge strip 5b of absorbent material. The central absorbent area 5a absorbs liquid as required, pulling in any liquid which arrives on the moat 7. Any small amounts of liquid arriving at the edge strip 5b are absorbed by the edge strip, thereby preventing any liquid from leaking from the composite material 4 and disposable products made therefrom.

In the embodiment of Fig 7, the composite material 4a comprises an additional layer 8 of non-absorbent, non-woven material which constitutes a skin contacting cover and is conveniently in the form of a non-woven fibrous material such as a scrim and may be of cellulose acetate, cellulose rayon, cotton fibre, a biodegradable thermoplastics material,

polycaprolactone or a preferably hydro-entangled web of cellulose fibrous material carrying a biodegradable thermoplastics such as BIOPOL (Trade Mark). The non-absorbent cover 8 is the innermost layer of a disposable product, such as a nappy or sanitary towel, for placing against the skin of a person and allows liquid to pass easily therethrough and into the absorbent layer 5, but guards against leakage of absorbed liquid out through the cover. Thus, the cover is leakage resistant.

So, the cover layer 8, like the soluble outer layer 2, the liquid impervious barrier layer 3 and the absorbent layer 5 can all be biodegradable.

The embodiment of composite material 4a shown in Fig 8 is particularly useful for making a disposable nappy such as is shown in Fig. 9.

In Figs 8 and 9, the disposable, flushable, biodegradable nappy which is generally indicated at 9 in Fig 9, comprises a composite material 4a comprising the outer layer 2 of soluble plastics material which is formed into the nappy proper. As will be apparent from Fig 8, the intermediate liquid impervious barrier 3 is bonded to the outer soluble layer by a water soluble adhesive 10 (eg PVA or CMC adhesive), and water soluble adhesive (eg PVA or CMC adhesive) strips 11, and soluble or non-soluble attaching strips 12 having, for example a heat bonding or adhesive capability, attach the cover layer 8 of scrim to the liquid impervious barrier layer 3, thereby holding the absorbent layer 5 to the barrier 3.

Additionally, the absorbent layer 5 can be optionally attached to the barrier layer 3 by adhesive dots 18. The absorbent layer 5 in this embodiment is conveniently in the form of a soft flock which is by nature fibrous.

In nappy form the composite material as described in Fig 8,

comprises the nappy proper 9 with its shaped outer layer 2a which is soluble having gusseted leg areas 13, elasticated waist bands 14, adhesive locating tabs 15 and location tabs 16 which are both made from the same soluble plastics material as the outer layer 2a. The soluble location tabs 16 are attached to the outer soluble layer 2a as by a soluble adhesive 17 such as a PVA or CMC adhesive.

In use the nappy is placed in position in the usual way and the adhesive tabs 15 are used to secure it on the child. When the liquid waste is absorbed by the absorbent layer 5, having entered it through the fabric of the leakage resistant cover 8, the cover then guards against leakage of the liquid held by the super absorbent flock from returning to the skin of the child. The attaching strips 12 when non-soluble stop the liquid held by the flock of the absorbent layer 5 from causing the cover 8 to be detached from the intermediate liquid impervious barrier 3, whilst the soluble adhesive strips 11 give the attaching strength. The intermediate liquid impervious barrier 3 does not allow the liquid held by the absorbent flock to reach and thus dissolve the material of the outer soluble layer 2.

When removed from the child, the nappy can be placed in the lavatory and immediately the soluble outer layer 2, soluble tabs and all water soluble adhesives begin to dissolve. The strips 12 attaching the cover 8 to the intermediate liquid impervious barrier 3 are no longer capable of sustaining adhesion between the two and the cover 8 is removed from the liquid impervious barrier 3 and dispersed by the action of the water flow in the lavatory. The super absorbent flock of the absorbent layer 4 now has no adhesion to the thin film barrier 3, loses its integrity by disintegrating and disperses and all that is left of the nappy is the micron thin liquid impervious barrier which is easily dispersed into the water flow and being biodegradable can be ingested by bacteria present in the sewage system.

The sanitary towel illustrated in figs 10 and 11 is generally indicated by the reference 19 and has an outer layer 2b of soluble material like the layer 2, shaped to form the supporting and dissolving layer suitable for a sanitary towel, with the intermediate liquid impervious barrier 3, the absorbent layer 5 and the leakage resistant cover 8. This embodiment differs from that of Fig. 7, in that the cover layer 8a which are secured to the outer face of the soluble layer 2b by means of a suitable water soluble adhesive such as PVA or CMC adhesive (not shown). Additionally, the outer face of the soluble layer 2b is provided with a peel-off strip 20 which is made of a biodegradable material such as BIOPOL material and exposes a strip of a pressure-sensitive water soluble adhesive 21, such as PVA or CMC adhesive, for attaching the sanitary towel 19 to a wearer's knickers. The various parts of the sanitary towel can be adhesively attached to one another as described with reference to Fig. 8 and disposal of the soiled towel by flushing down the lavatory takes place in a similar way.

Referring now to Fig 12, there is shown a pair of disposable incontinence knickers 22 of which the outer soluble layer 2 of the composite material 4a illustrated in Fig. 7, has been formed into a knickers configuration having an outer soluble layer 2c and a non-absorbent leakage resistant cover 8. Disposal via a flushing system such as a water closet or lavatory takes place in a similar way to that described for the nappy of Fig 9.

It should be appreciated that the adhesive strips 11 and 12 shown in Fig 8 can be used to attach the leakage resistant cover 8 to the liquid impervious barrier 3 in all the embodiments having a cover 8 and that these strips can hold the absorbent layer 5 to the barrier 3 without their being any need for an adhesive such as 18 therebetween.

The embodiment of Figs 13 and 14 represents somewhat of a

departure from the previously described disposable products which are designed for wear, in that the composite material 4 of Fig 13 is used to form an absorbent bag 24 shown in Fig. 14. The bag 24 has an inwardly facing absorbent layer 5 presenting a highly absorbent surface 23 (Fig 13), an intermediate liquid impervious barrier layer 3 which is constituted by an adhesive film and by means of which the absorbent layer 5 is attached thereto. The outer soluble layer 2 of Fig. 13 is shaped to form the outer soluble layer 2d of the bag, with the liquid impervious barrier 3 of adhesive film attaching the layer 2d thereto. Whenever there is a need temporarily to store wet or damp articles such as clothing, towels, swimming costumes, used nappies, sanitary towels etc., the bag 24 can safely be used without the risk of leakage, as any excess liquid is absorbed and held by the absorbent layer 5. Disposal of the used bag by flushing, for example, occurs in a similar manner to that described with reference to the nappy of Fig. 9, except that in the embodiment of Figs. 13 and 14, the cover 8 and cover attaching adhesives are omitted because they are not necessary.

Applicant has found the embodiment of absorbent material 5 illustrated in Fig. 16 to be particularly useful as it satisfies both the super-absorbability requirements and the most stringent biodegradability requirements which are being applied nowadays. Thus, the absorbent layer 5 comprises three members, namely a central core member constituted by a non-woven fibrous hydro-entangled web 30 of CMC, fluff pulp and cellulose rayon and two outer members 31 and 32, each of three layer formation and comprising a respective middle fibrous layer 31b and 32b of CMC sandwiched between two outer fibrous layers of cellulose 31a, 31c and 32a, 32c respectively.

Whilst particular embodiments have been described, it should be appreciated that modifications and variations can be made without departing from the scope of the invention. For example, any of the materials described for the layers of the

composite material and disposable products in the various embodiments can be used in other embodiments. Moreover, instead of being carried by the soluble layer 2 (2a,2b,2c or 2d) the liquid impervious barrier 3 may be carried by the absorbent layer 5. The embodiment of composite material 4a shown in Fig. 8, could, in itself, be used as an incontinence pad.

Moreover, the composite materials of the present invention may be used to produce disposable products other than those described herein.

Furthermore, in the case of nappies, the composite material 4a in Fig. 8, for example, could be supported by an insoluble plastics outer cover 25 by means of say pockets 26, complete with attachment means 15, gusseted leg portions and elasticated waist bands 14 for use again and again with successive disposable linings of the composite material 4a as shown in Fig. 15.

CLAIMS

1. A composite material comprising a soluble layer and a liquid impervious barrier, said soluble layer and said barrier being in synergistic relationship.

2. A composite material as claimed in Claim 1, wherein the synergistic relationship works by each of the soluble layer and liquid impervious barrier relying upon the other to maintain its integrity during normal use.

3. A composite material as claimed in Claim 2, wherein the integrity of the soluble layer and liquid impervious layer is maintained during normal use by the soluble layer having sufficient mechanical strength and handling capability for an ultimate disposable product and the liquid impervious barrier guarding against liquid reaching the soluble layer.

4. A composite material as claimed in claim 3, wherein the liquid impervious barrier has insufficient strength and handling capability to maintain its integrity without the support of the soluble layer.

5. A composite material comprising a soluble layer and a liquid impervious barrier arranged such that when exposed to a liquid such as water the soluble layer loses its integrity, thereby causing the liquid impervious barrier also to lose its integrity.

6. A composite material as claimed in any one of Claims 1 to 5, wherein the soluble layer and liquid impervious barrier are biodegradable.

7. A composite material as claimed in any one of Claims 1 to 6, wherein the soluble layer is made of a material selected from at least one of polyvinyl alcohol, carboxymethyl

cellulose, and an alginate derived substance.

8. A composite material as claimed in any one of Claims 1 to 7, wherein the liquid impervious barrier is made of a material selected from at least one of polyvinylidenechloride, polycaprolactone, non-petrochemical based thermoplastics, and homogenous amalgams or combinations containing thermoplastic biodegradable substances.

9. A composite material as claimed in any one of claims 1 to 8, wherein the liquid impervious barrier is bonded to the soluble layer.

10. A composite material as claimed in claim 9, wherein the bonding is at least one of heat bonding, ultrasonic bonding, lamination or adhesive bonding.

11. A composite material is claimed in any one of claims 1 to 8, wherein the soluble layer and liquid impervious barrier are formed at the same time, eg by extrusion, to form a one piece synergistic whole.

12. A composite material as claimed in any one of claims 1 to 8, wherein the liquid impervious barrier is formed as a coating on one surface of the soluble layer.

13. A composite material as claimed in any one of claims 1 to 8, wherein the liquid impervious barrier is constituted by a film or coating of adhesive.

14. A composite material as claimed in claim 10, wherein the adhesive is a water soluble adhesive such as a polyvinyl alcohol or carboxymethyl cellulose adhesive.

15. A composite material as claimed in any one of claims 1 to 14, wherein the soluble layer has a thickness of from about 20 to about 35 microns.

16. A composite material as claimed in any one of claims 1 to 15, wherein the liquid impervious barrier has a thickness of about 1 micron to about 10 microns and preferably about 2 to microns.

17. A composite material as claimed in any one of claims 1 to 16, wherein the soluble layer supports a disintegratable and dispersible liquid absorbent material with the liquid impervious barrier being interposed therebetween, whereby the integrity of the absorbent material is maintained during normal use but loses its integrity when exposed to a liquid such as water.

18. A composite material comprising a disintegratable liquid absorbent material which loses its integrity and disperses when the composite material is exposed to a liquid such as water.

19. A composite material comprising a layer of soluble material, a layer of absorbent material which is capable of absorbing and holding a liquid and which is supported by the soluble layer, and a liquid impervious barrier which is interposed between the absorbent layer and the soluble layer, each of said soluble layer and liquid impervious barrier being capable, during normal use, of maintaining the integrity of the other and thus of the composite material including the absorbent layer, so that the absorbent layer can absorb and hold liquid without disintegration of the composite material.

20. A composite material as claimed in any one of claims 17 to 19, wherein the liquid absorbent material includes at least one material whose absorptive action involves at least one of capillarity, wicking and molecular containment.

21. A composite material as claimed in any one of claims 17 to 20, wherein the absorbent material comprises a web of at least one fibrous material.

22. A composite material as claimed in claim 21, wherein the constituents of the web are held together during normal use without relying on heat bonded fibres.

23. A composite material as claimed in claim 22, wherein the web is formed in the presence of water vapour causing the constituents of the web to be adhered together sufficiently to hold the constituents of the web together during normal use yet permit loss of integrity when the composite material is exposed to a liquid such as water.

24. A composite material comprising a web of a non-woven disintegratable liquid absorbent material of which the individual constituents of the web have been held together by the use of water, but whose integrity is lost when the composite material is exposed to a liquid such as water.

25. A composite material as claimed in claim 17 to 24, wherein the web is formed of at least one fibrous material.

26. A composite material as claimed in any one of claims 17 to 25, wherein the absorbent material comprises at least one substance selected from cross-linked monomers of isobutylene and maleic anhydride, polypropylene, viscose rayon, a biodegradable thermoplastic material, fluff pulp, carboxymethyl cellulose, cellulose rayon, potato derived adsorbents and modified starches.

27. A composite material as claimed in claim 26, wherein the absorbent material comprises carboxymethyl cellulose, and/or potato derived adsorbents, fluff pulp and cellulose rayon fibre.

28. A composite material as claimed in claim 27, wherein absorbent material comprises about 35% to about 60% by weight carboxymethyl cellulose and/or potato derived adsorbents, about 35% to about 50% by weight fluff pulp and about 5% to

about 15% by weight cellulose rayon fibre and preferably about 50% by weight carboxymethyl cellulose and/or potato derived adsorbents, about 35% by weight fluff pulp and about 15% by weight cellulose rayon fibre.

29. A composite material as claimed in claim 26, wherein the absorbent material comprises about 50% by weight cellulose rayon fibre and about 50% by weight carboxymethyl cellulose, and/or potato derived adsorbents, and/or modified starches.

30. A composite material as claimed in claim 26, wherein the absorbent material comprises cross-linked monomers of isobutylene and maleic anhydride in combination with at least one of polypropylene, viscose rayon, fluff pulp, a biodegradable thermoplastics material and carboxymethyl cellulose.

31. A composite material as claimed in claim 26, wherein the absorbent material comprises about 50% by weight viscose rayon in upper and lower webs or layers formed with about 50% by weight carboxymethyl cellulose or other biodegradable adsorbents sandwiched therebetween.

32. A composite material as claimed in claim 26, wherein the absorbent material comprises a central web member of carboxymethyl cellulose, fluff pulp and cellulose rayon fibres, and two outer members each of which includes three layers of which the middle layer is carboxymethyl cellulose sandwiched between two layers of cellulose rayon fibres.

33. A composite material as claimed in any one of claims 17 to 32, wherein the absorbent material is present in a weight of from about 70 gsm to about 400 gsm and preferably about 70 gsm to about 250 gsm.

34. A composite material as claimed in any one of claims 17 to 33, wherein the absorbent material is attached to the

liquid impervious barrier by adhesive action.

35. A composite material as claimed in claim 34, wherein the adhesive is a water soluble adhesive such as a polyvinyl alcohol or carboxymethyl cellulose adhesive.

36. A composite material as claimed in any one of claims 17 to 35, wherein the absorbent material is biodegradable.

37. A composite material as claimed in any one of claims 1 to 36, wherein the absorbent material is covered by a skin contacting cover which provides ease of passage of the liquid to be absorbed therethrough and into the absorbent material.

38. A composite material comprising a disintegratable liquid absorbent material which is covered by a skin contacting cover which provides ease of passage of a liquid to be absorbed therethrough and into the absorbent material.

39. A composite material as claimed in claim 37 or 38, wherein the cover has resistance to leakage of liquid from the absorbent material out through the cover.

40. A composite material as claimed in any one of claims 37 to 39 wherein the cover is absorbent resistant or relatively non-absorbent.

41. A composite material as claimed in any one of claims 37 to 40 and in the form of a scrim.

42. A composite material as claimed in any one of claims 37 to 41, wherein the cover is attached along its edges or edge regions to the absorbent material.

43. A composite material as claimed in any one of claims 37 to 42, wherein the cover is folded over the edges of the

absorbent material to be attached to the or a soluble outer layer.

44. A composite material as claimed in claim 42 or 43, wherein the attachment of the cover is by means of a water soluble adhesive such as a polyvinyl alcohol or carboxymethyl cellulose adhesive.

45. A composite material as claimed in any one of claims 37 to 44, wherein the cover is made of a fibrous material.

46. A composite material as claimed in any one of claims 37 to 45, wherein the cover is made of a material selected from at least one of cellulose acetate fibres, biodegradable thermoplastics fibres, cellulose rayon fibres carrying a biodegradable thermoplastics material, cotton and polycaprolactone.

47. A composite material as claimed in claim 46, wherein the biodegradable thermoplastics material has been applied in the form of an emulsion to a web of the cellulose rayon fibres.

48. A composite material as claimed in any one of claims 37 to 47, wherein the cover is made of a biodegradable material.

49. A composite material as claimed in any one of claims 37 to 48, wherein the cover is in the form of a layer having a thickness of about 5 to about 10 microns.

50. A composite material as claimed in any one of claims 37 to 49, wherein the constituents of the cover are held together using water.

51. A composite material for use as, or to provide, a disposable product such as a nappy, sanitary towel, incontinence pad or knickers, the composite material being constituted by substances that are flushable, biodegradable

and capable of losing their integrity by the natural action of the environment or in a water flushing system, whereby the dissolution or disintegration and ultimate dispersion can take place without any harm being done to the environment.

52. A disposable product such as a nappy/diaper, sanitary towel, incontinence pad or knickers, comprising a composite material as claimed in any one of the preceding claims.

53. A method of producing an absorbent material as recited in any one of claims 17 to 36, wherein a web of non-woven absorbent substances is formed and wherein the individual constituents of the web are held together by the action of water.

54. A method of producing a cover as recited in any one of claims 37 to 50, wherein a web of non-woven substances is formed and wherein the individual constituents of the web are held together by the action of water.

55. A method as claimed in claim 53 or 54, wherein the web is formed in the presence of water vapour such as in a humid atmosphere to hold the individual constituents of the web together.

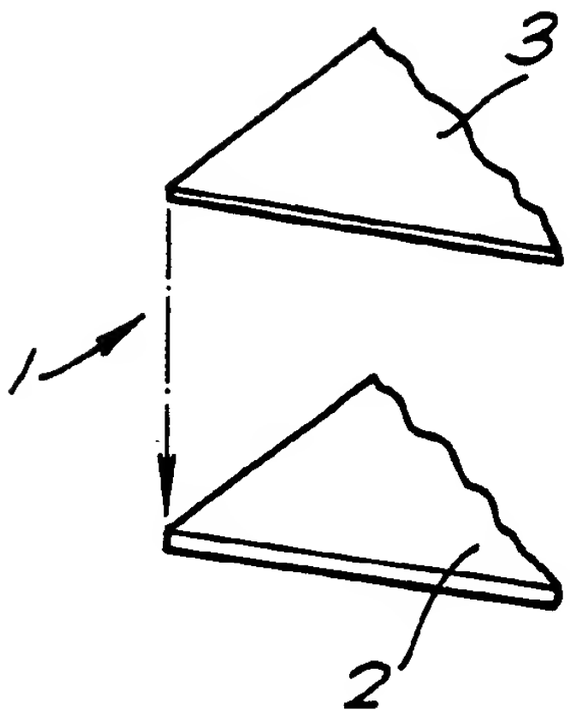


FIG. 1

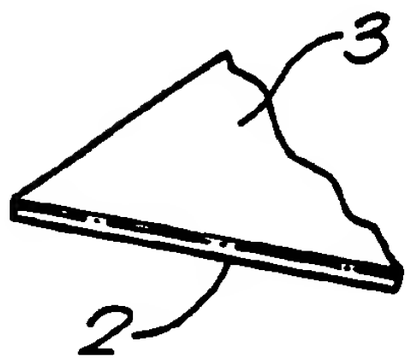


FIG. 2

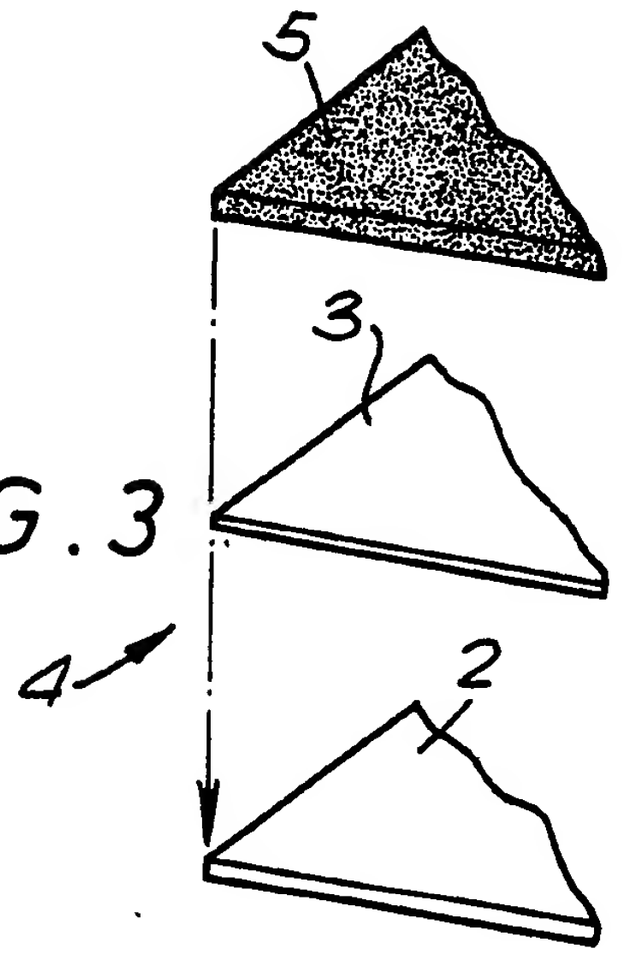


FIG. 3

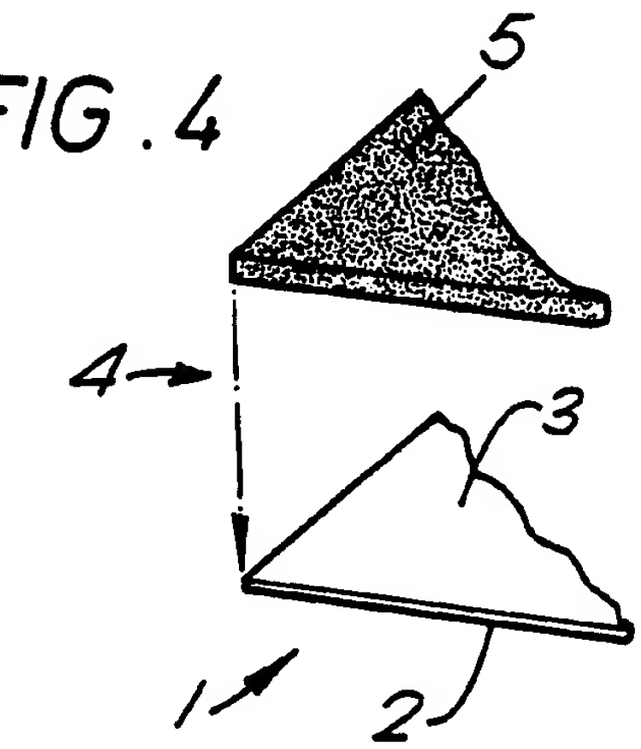


FIG. 4

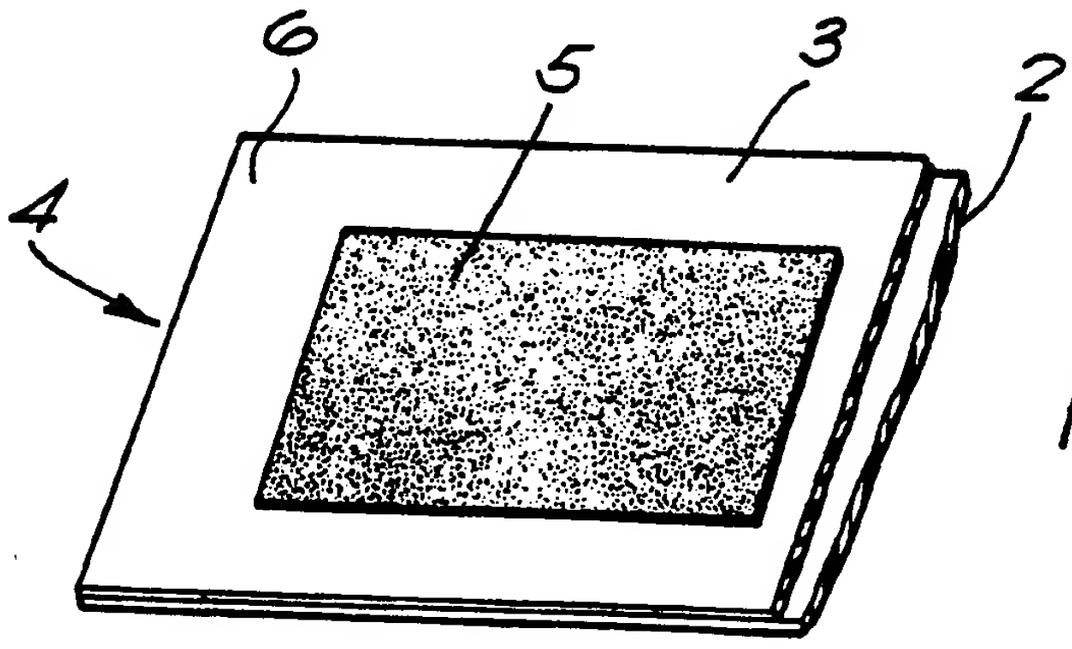


FIG. 5

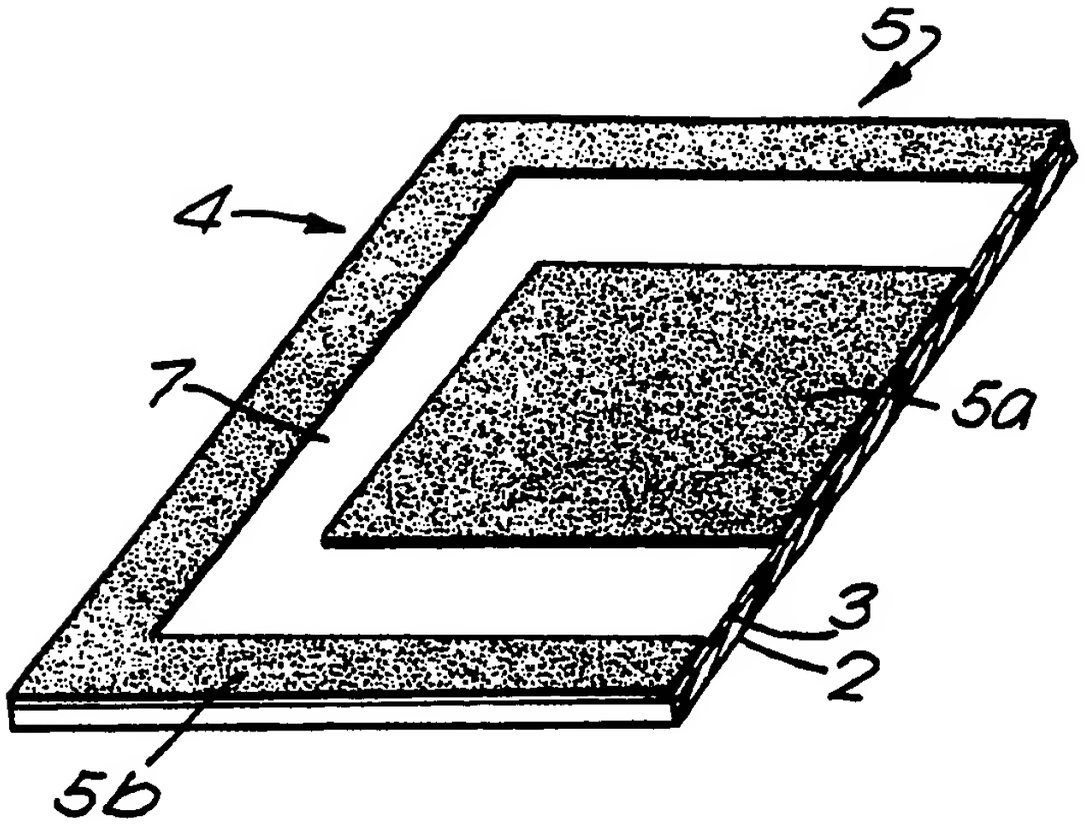


FIG. 6

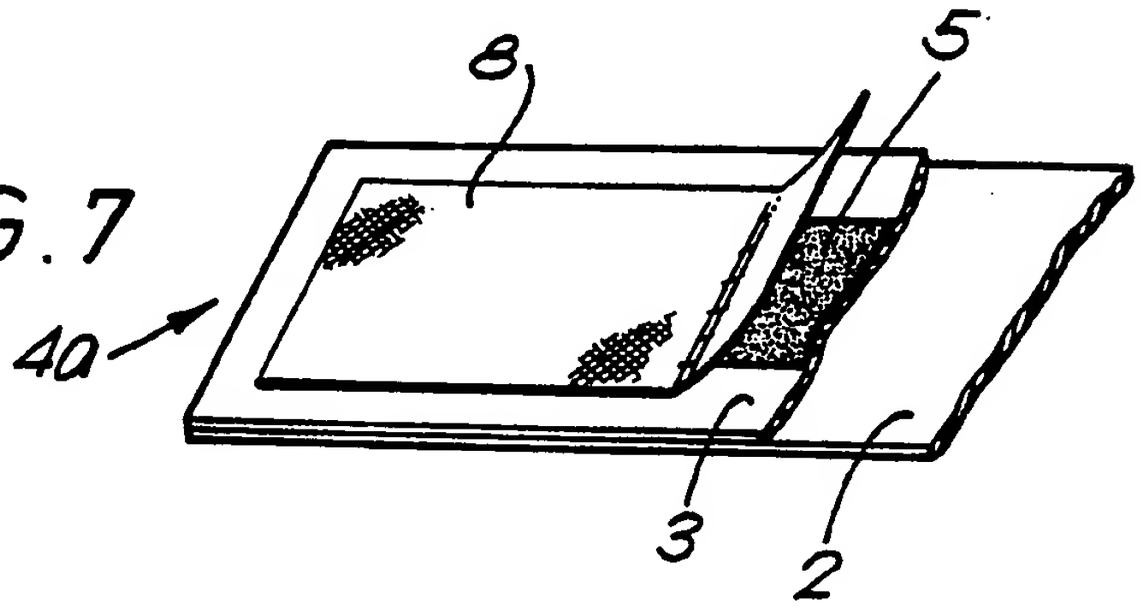


FIG. 7

FIG. 10

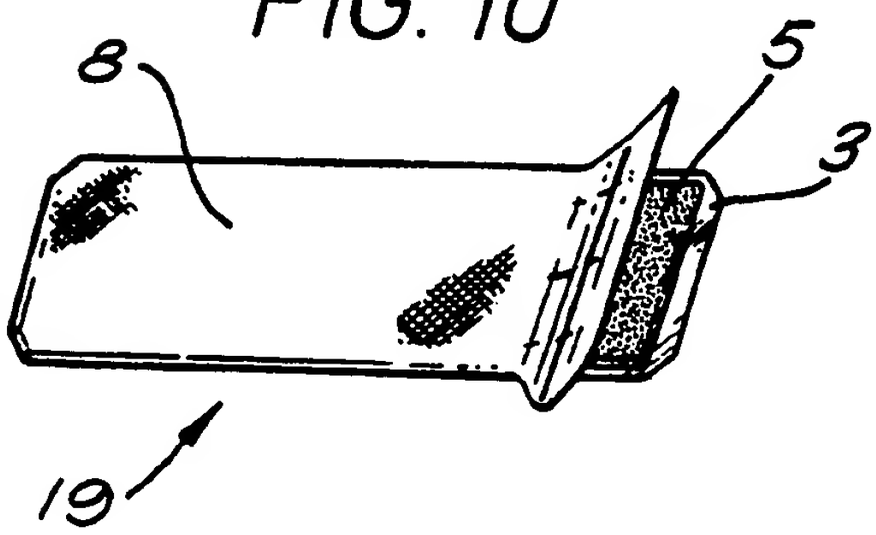


FIG. 11

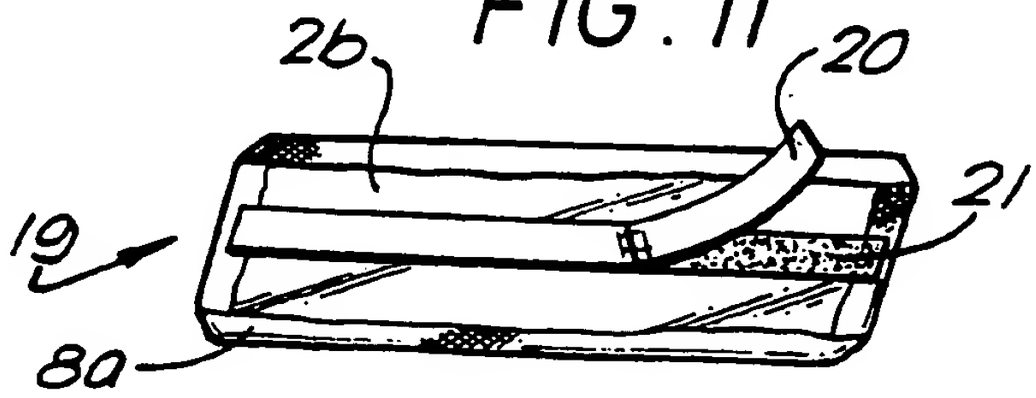


FIG. 8

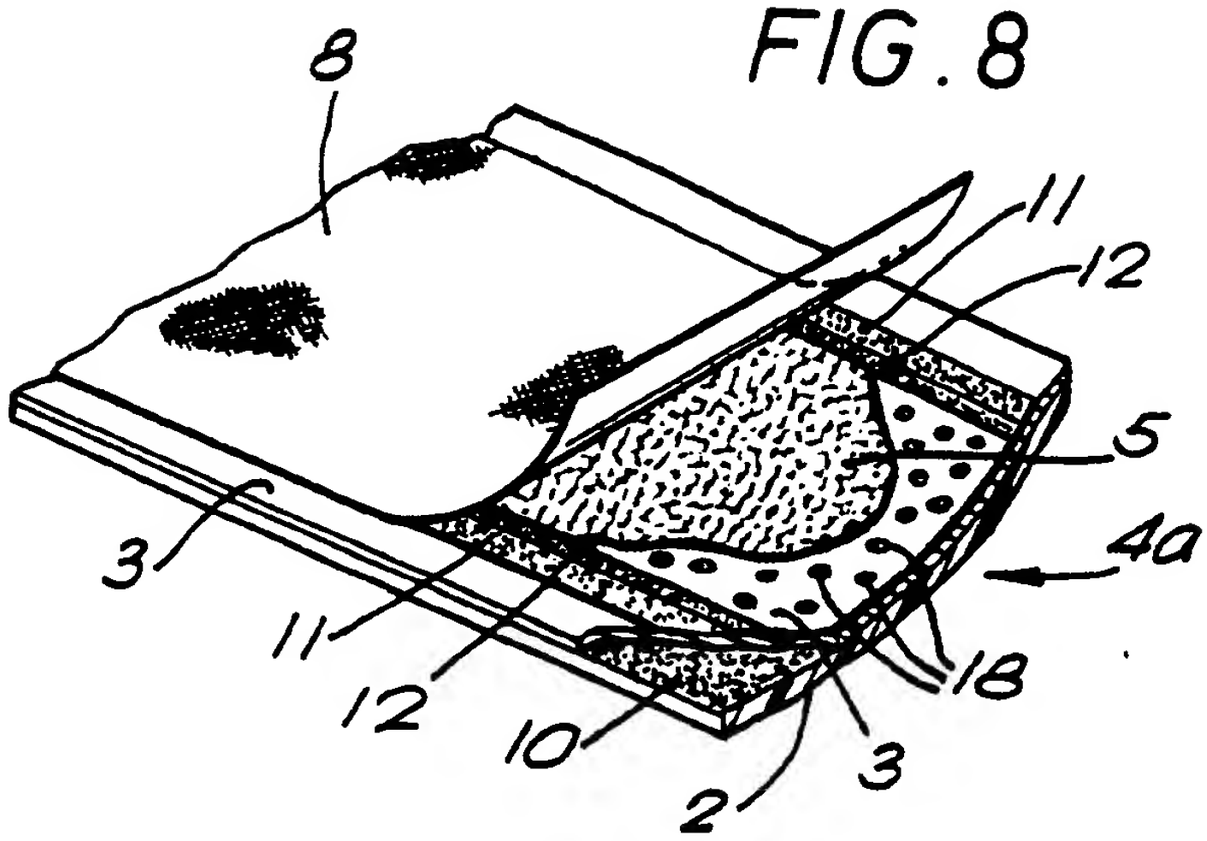
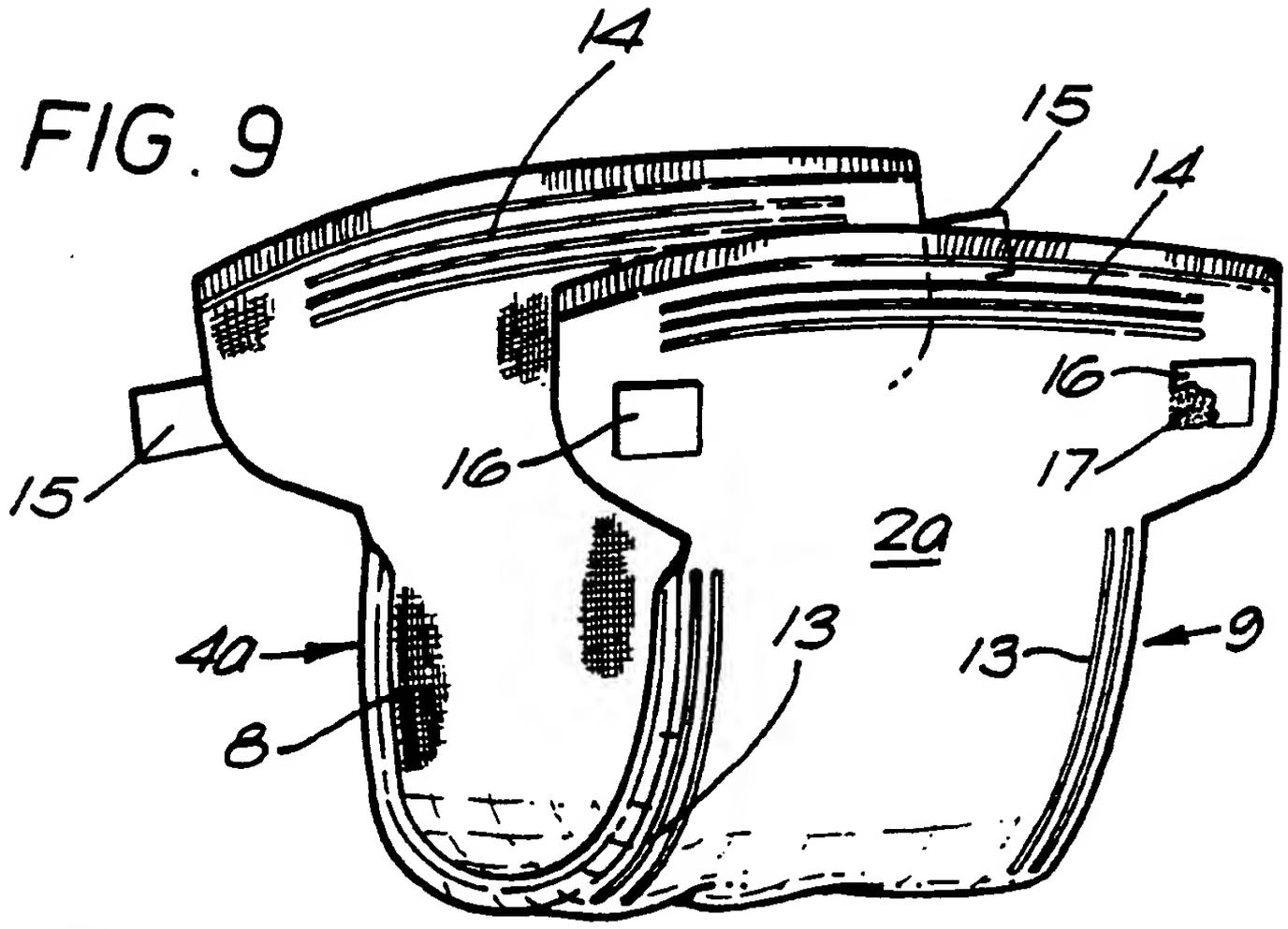


FIG. 9



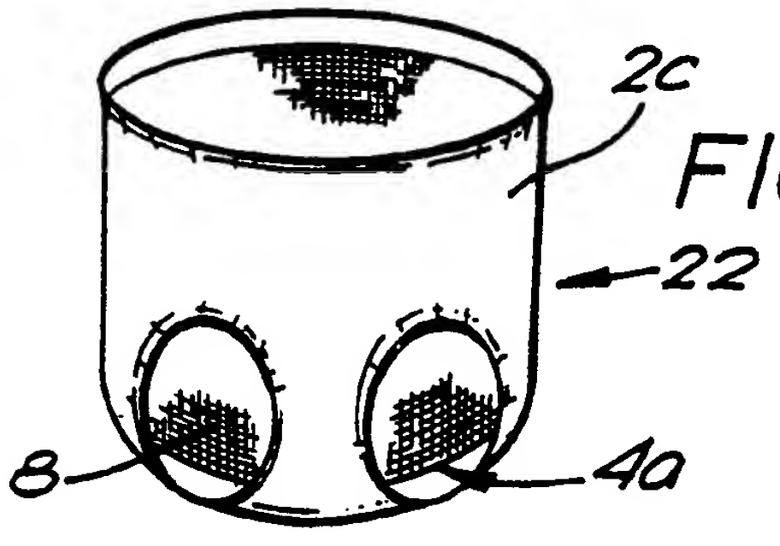


FIG. 12

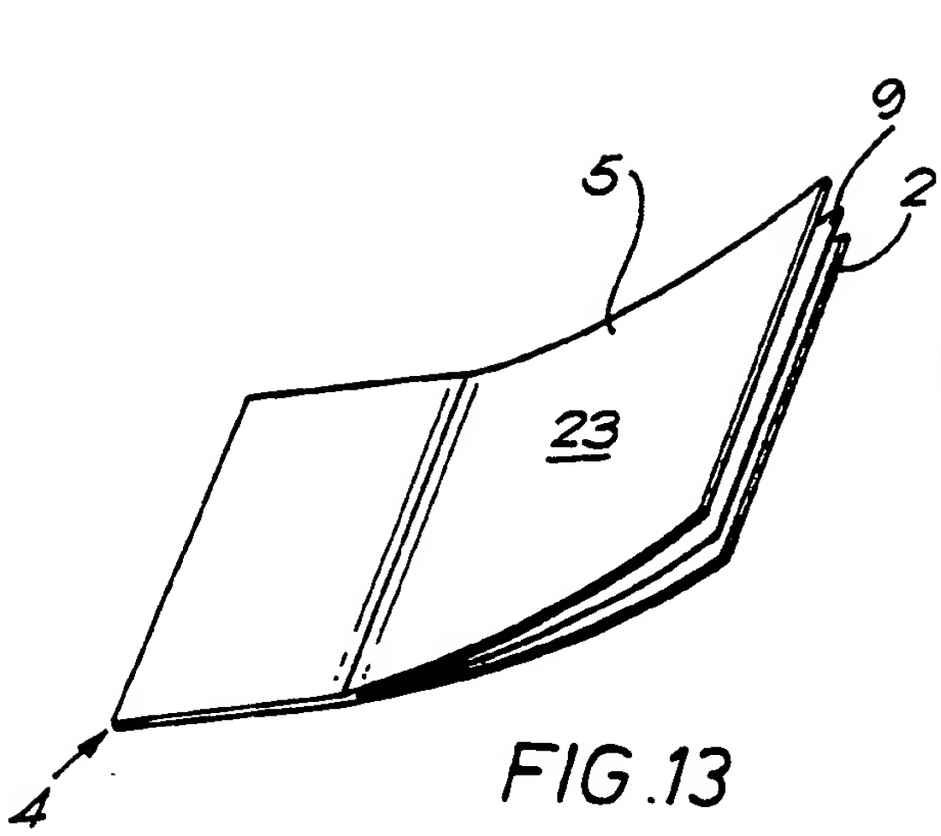


FIG.13

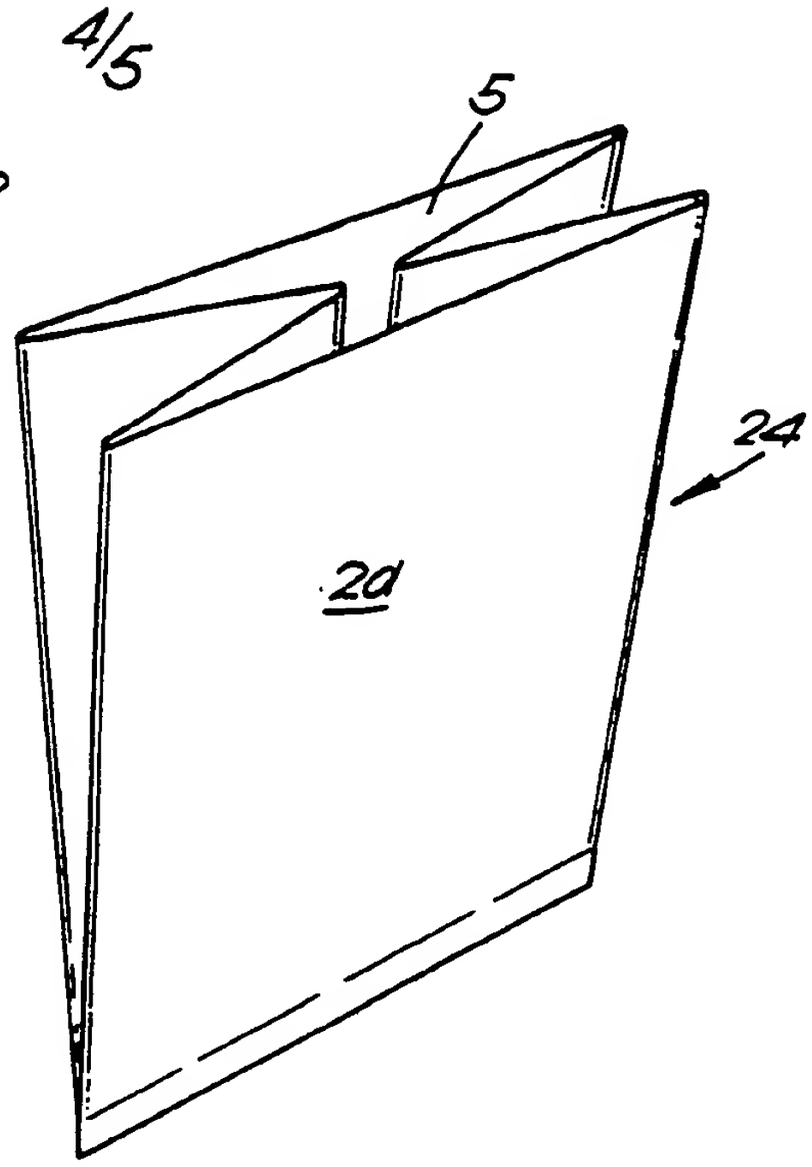


FIG.14

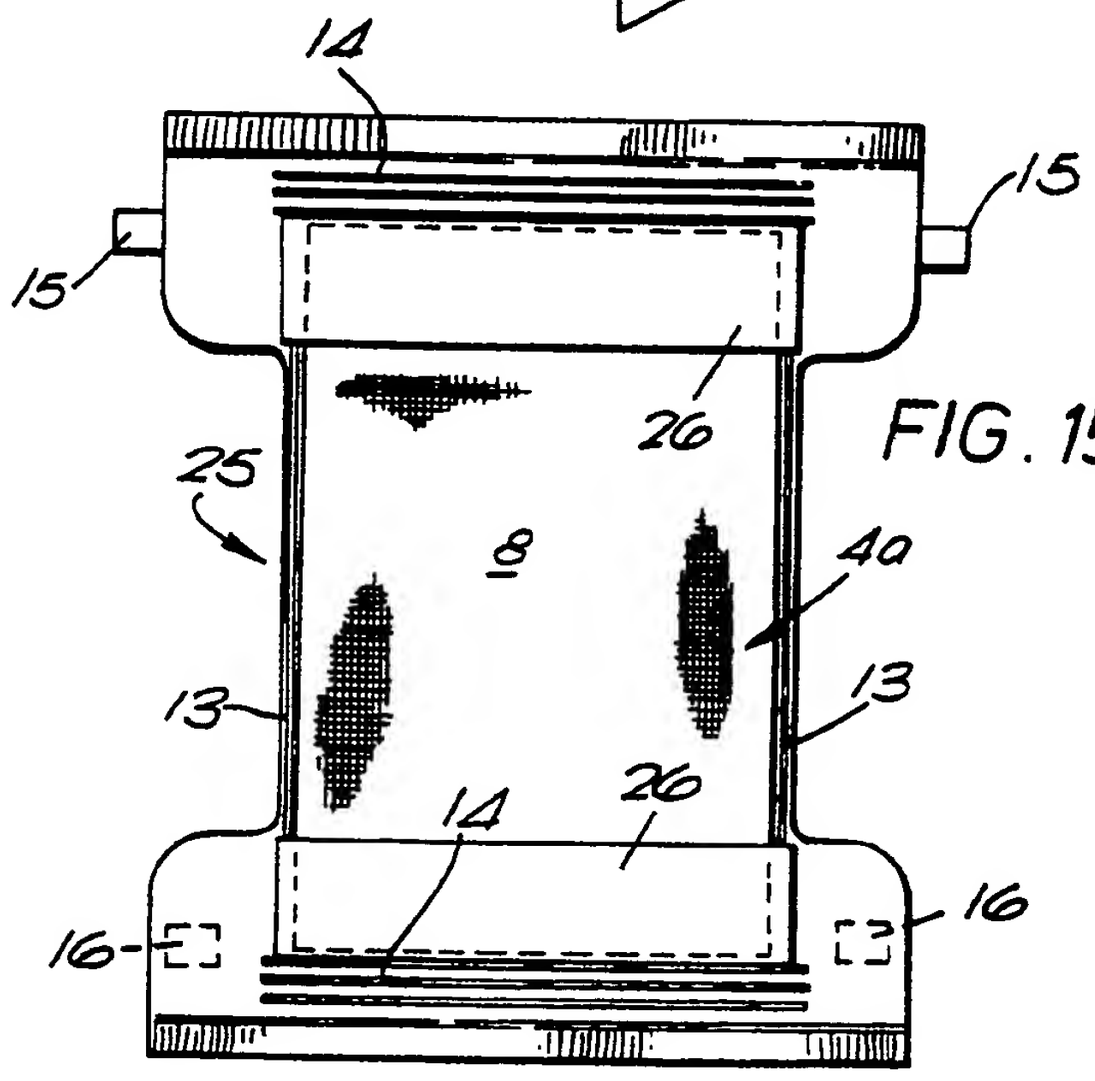
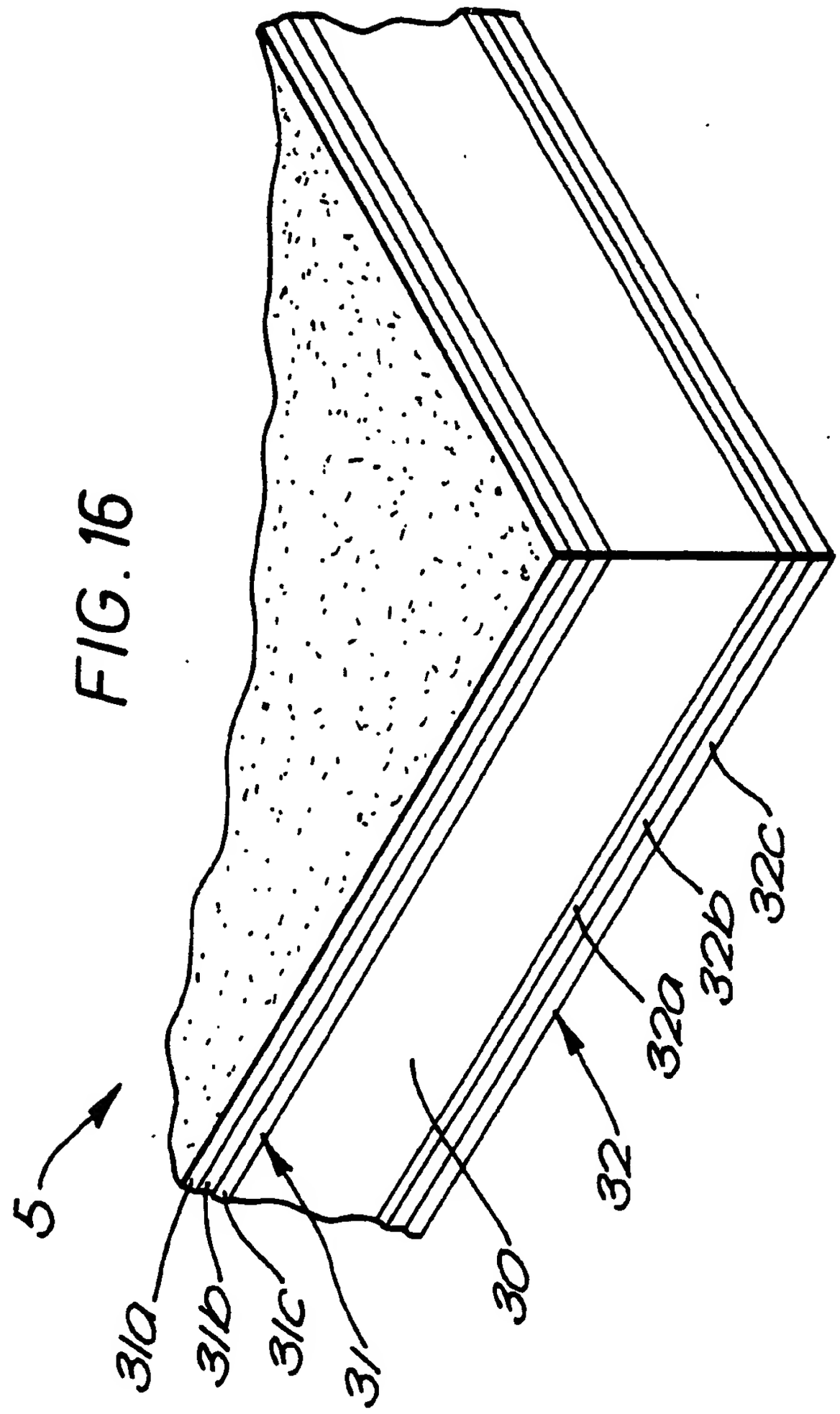


FIG.15

FIG. 16



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 91/01367

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A61F13/15

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	A61F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category [a]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	WO,A,9 004 456 (J. K. BETHUNE) 3 May 1990 see page 1, line 13 - page 3, line 25 see page 7, line 8 - line 18 ---	1-10, 17-26, 53-54
X	US,A,4 503 098 (J. E. POTTS) 5 March 1985 see column 1 - column 2; claims ---	1-9,11, 12,15, 16,18, 51-53
Y		13,14, 17-37, 39-50

-/--

* Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
29 NOVEMBER 1991	09 DEC 1991
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	ARGENTINI A.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X,P	US,A,4 964 857 (R. R. CHARLES OSBORN) 23 October 1990	38
Y	see the whole document	17-37, 39-43, 45-50
Y	EP,A,0 130 061 (E.R. SQUIBB & SONS, INC) 2 January 1985 see page 5, line 13 - page 6, line 23	13-14, 34-36,44
A	FR,A,2 627 080 (CELATOSE S.A.) 18 August 1989	1-55

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9101367 SA 50510

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9004456	03-05-90	None		
US-A-4503098	05-03-85	US-A-	4372311	08-02-83
US-A-4964857	23-10-90	None		
EP-A-0130061	02-01-85	US-A-	4551490	05-11-85
		AU-B-	578612	03-11-88
		AU-A-	2950184	10-01-85
		CA-A-	1225764	18-08-87
		DE-A-	3473731	06-10-88
		JP-A-	60020976	02-02-85
FR-A-2627080	18-08-89	None		